



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of : **Confirmation No. 8103**  
Ola OLSVIK : Docket No. 2001-0263A  
Serial No. 09/787,301 : Group Art Unit 1754  
Filed March 16, 2001 : Examiner Jonas N. Strickland

METHOD FOR PREPARING A H<sub>2</sub>-RICH GAS  
AND A CO<sub>2</sub>-RICH GAS AT HIGH PRESSURE

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**RESPONSE**

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

**THE COMMISSIONER IS AUTHORIZED  
TO CHARGE ANY DEFICIENCY IN THE  
FEE FOR THIS PAPER TO DEPOSIT  
ACCOUNT NO. 23-0975.**

Sir:

Responsive to the Office Action of March 2, 2004, Applicant submits the following remarks in support of the patentability of the presently claimed invention over the disclosure of the references relied upon by the Examiner in rejecting the claims. Further and favorable reconsideration is respectfully requested in view of these remarks.

Thus, the rejection of claims 21-31 under 35 U.S.C. §103(a) as being unpatentable over Pagani in view of JP 05295374A (JP '374) is respectfully traversed.

The Examiner takes the position that Pagani discloses a steam reforming of methane, which reacts with steam on a special catalyst. The Examiner further states that Pagani continues to disclose wherein the reforming process occurs in a range from 50 to 250 bar, a temperature in the reforming reactor of 550°C, as well as producing a gas comprised of hydrogen and carbon dioxide. However, the Examiner admits that Pagani does not disclose wherein the carbon dioxide and hydrogen stream are separated. The Examiner relies upon JP '374, stating that the reference teaches reforming methane with steam to produce hydrogen and carbon dioxide, wherein hydrogen is separated and carbon dioxide is also separated. The Examiner asserts that it would have been obvious to one of

ordinary skill in the art to modify the teachings of Pagani, based on the teachings of JP '374, because JP '374 teaches separating hydrogen and carbon dioxide produced from a steam reforming process. The Examiner further asserts that one of ordinary skill in the art would have expected a steam reforming process which reacts methane and steam to produce hydrogen and carbon dioxide as taught by JP '374 to have been similarly useful and applicable to a steam reforming process which also teaches producing carbon dioxide and hydrogen as taught by Pagani.

The present invention is directed to a method for preparing a CO<sub>2</sub>-rich gas stream and a H<sub>2</sub>-rich gas stream which involves subjecting a gas mixture of natural gas and H<sub>2</sub>O to a one-step reforming reaction under supercritical heat and pressure conditions for water to form a reformed gas mixture, and separating the reformed gas mixture into a H<sub>2</sub>-rich gas stream and a CO<sub>2</sub>-rich gas stream, as set forth in claim 21.

On the other hand, as most apparent from page 1 and claim 1 of Pagani, this reference is concerned with a steam reforming process for the production of a synthesis gas "of carbon monoxide and hydrogen" (claim 1), which is then used for the synthesis of ammonia and methanol (page 1, lines 17-21). Although the reactions shown on page 2 of the reference include CO<sub>2</sub> and the composition of the fumes and the transformed gas include CO<sub>2</sub>, this is merely one component of these gases, referring again to the reactions in the paragraph bridging pages 1 and 2 of the reference. There is no separation of the "transformed gas" (page 4, line 11) into a H<sub>2</sub>-rich gas stream and a CO<sub>2</sub>-rich gas stream as required in the present invention.

JP '374 teaches reforming of liquefied natural gas for the recovery of high-purity hydrogen and carbon-dioxide, including liquefying the carbon dioxide after separating the hydrogen. JP '374 strives to achieve a minimization of heat loss and economy of energy in connection with the production of a liquefied CO<sub>2</sub>. Unlike the present invention, JP '374 teaches a purity of 99.9% or higher, likely intended for an industrial processes requiring a very pure hydrogen stream. On the contrary, the present invention produces a hydrogen stream with a lower hydrogen concentration, but which is sufficient for the main purpose of using the hydrogen stream as a fuel in a power plant. Additionally, the present invention produces a CO<sub>2</sub> stream at an elevated pressure which beneficially results in less power consumption when the CO<sub>2</sub> stream is further compressed for injection purposes

or when it is used for Enhanced Oil Recovery of an oil reservoir requiring an injection pressure of possibly 200-500 bar or more at the wellhead.

The Examiner takes the position that it would have been obvious, based upon the teachings of JP '374, to modify the teachings of Pagani by separating hydrogen and carbon dioxide. However, to the contrary, Pagani discloses that a transformed gas containing carbon dioxide and hydrogen is produced. The reference does not disclose or suggest that the transformed gas is separated into a carbon dioxide rich gas stream and a hydrogen rich gas stream, nor does the reference provide any motivation to alter the disclosed process. In fact, to the contrary, the object of the Pagani reference is to produce synthesis gas of carbon monoxide and hydrogen (page 1 and claim 1) for the synthesis of ammonia and methanol (page 1, lines 17-21). Modifying the teachings of Pagani based upon the teachings of JP '374, to separate the transformed gas resulting from the reforming reaction into a carbon dioxide rich gas stream and a hydrogen rich gas stream as argued by the Examiner, would in fact defeat the very purpose of the process disclosed by Pagani, and accordingly, combining the references is improper. Ex parte Hartmann, 186 USPQ 366.

Applicant also respectfully submits that this rejection is based on hindsight, which is improper according to U.S. practice. The Examiner has cited no evidence to support his conclusion that it would have been obvious to modify Pagani by separating hydrogen and carbon dioxide, based upon the teachings of JP '374. In the absence of such evidence, the rejection of claims 21-31, based on Pagani in view of JP '374 should be withdrawn. In re Zurko, 59 USPQ2d 1693.

Additionally, Applicant notes that the Pagani reference relates to a conventional method of producing H<sub>2</sub> and CO<sub>2</sub> whereas the present invention regards the production of H<sub>2</sub> and CO<sub>2</sub> under supercritical conditions for water. The reference describes preparation of synthesis gas by steam reforming of hydrocarbons in a gas and liquid at 50-250 bar absolute atmosphere, preferably 160 bar absolute for production of ammonia and methanol. The reference does not disclose a one step process for production of a CO<sub>2</sub> rich gas and H<sub>2</sub> rich gas under supercritical conditions for water (claim 21), where a CO<sub>2</sub> rich gas mixture is taken out at an elevated pressure in the interval from 20 to 200 bar (claim 25) for injection into marine formations (claim 37). The present invention involves reduced compression costs and energy consumption by deposition or injection of the CO<sub>2</sub> rich gas stream

because the CO<sub>2</sub> rich gas mixture is taken out at an elevated pressure. A main principle of the present invention is that the CO<sub>2</sub> is produced under supercritical conditions for the purpose of "Enhanced Oil Recovery" (EOR). The pressure range according to Pagani is 50 to 200 bar and the reference does not specify a temperature range. The present invention specifies a pressure range between 200 and 500 bar (claim 24) and a temperature range 400 to 600°C (claim 22). The present invention has defined a range for both temperatures and pressures which achieves supercritical conditions for the water. According to the present invention Applicant achieves an energy efficient and environmentally friendly source of carbon dioxide and hydrogen for use as shown in Figure 1 of the present application. Combining the teachings of Pagani with the teachings of JP '374 does not remedy the above discussed deficiencies.

For these reasons, Applicant takes the position that the presently claimed invention is patentable over Pagani and JP '374.

The rejection of claims 32-36 under 35 U.S.C. §103(a) as being unpatentable over Pagani in view of JP '374 as applied to claims 21-31, and further in view of Kapoor et al. is respectfully traversed.

The Examiner asserts that Pagani teaches using a catalyst in the reformer for producing a carbon dioxide and hydrogen gas mixture, and acknowledges that this reference does not teach using a reformer without a catalyst. The Examiner further asserts that Kapoor et al. teach a process wherein a hydrocarbon is contacted with water vapor to produce a gaseous effluent comprised of hydrogen and carbon dioxide, wherein the reforming reaction is carried out with a catalyst, but may be carried out thermally. The Examiner states that it would have been obvious to one of ordinary skill in the art to modify the teachings of Pagani in view of JP '374 based upon the teachings of Kapoor et al., but carrying out the reforming reaction without a catalyst because Kapoor et al. disclose a process for producing hydrogen and carbon dioxide, wherein the reforming reaction is not driven with a catalyst, but through thermal treatment. The Examiner asserts that such a modification would have been obvious because one of ordinary skill in the art would expect a process for producing hydrogen and carbon dioxide with a reformer reactor as taught by Kapoor et al. to be similarly useful and

applicable to a process for producing hydrogen and carbon dioxide with a reforming reactor as taught by Pagani in view of JP '374.

Claims 32-36 are all dependent, directly or indirectly, on claim 21, which is considered to be patentable over Pagani in view of JP '374 for the reasons set forth above. Therefore, even if Kapoor et al. is considered, the references still do not suggest the presently claimed invention.

Since the Examiner relies on Kapoor et al. only for the proposition that it would have been obvious to modify Pagani in view of JP '374 based on the teachings of Kapoor et al. by carrying out the reforming reaction without a catalyst, no further comments about Kapoor et al. are considered to be necessary.

The rejection of claim 37 under 35 U.S.C. §103(a) as being unpatentable over Pagani in view of JP '374 as applied to claims 21-31, and further in view of Ronning et al. is respectfully traversed.

The Examiner acknowledges that Pagani in view of JP '374 does not teach injecting the separated carbon dioxide rich gas stream into marine formations. The Examiner states that Ronning et al. teach a method for removing carbon dioxide from exhaust gases and wherein carbon dioxide can be compressed and injected into deep sea water. The Examiner asserts that it would have been obvious to one of ordinary skill in the art to modify Pagani in view of JP '374, based on the teachings of Ronning et al., by injecting carbon dioxide into marine formulations, because Ronning et al. teaches a method for removing carbon dioxide and injecting carbon dioxide into deep sea water.

The comments set forth above concerning the combination of Pagani and JP '374 are equally applicable to this rejection.

Since the references have been combined by the Examiner only for rejecting claim 37, it is apparent that the references would not suggest the present invention because, as indicated above, Pagani in view of JP '374 fails to suggest the subject matter of claim 21 on which claim 37 depends.

The rejection of claims 38-40 under 35 U.S.C. §103(a) as being unpatentable over Pagani in view of JP '374 as applied to claims 21-31, and further in view of Beshty is respectfully traversed.

The Examiner acknowledges that Pagani does not teach a method for producing hydrogen wherein the produced hydrogen may be used for hydrogenation, for fuel cells, and the production of electricity. The Examiner asserts that Beshty teaches a process for producing hydrogen by steam

reforming, wherein hydrogen may be used for hydrogenation, and in fuel cells for the generation of energy. The Examiner asserts that it would have been obvious to one of ordinary skill in the art to modify the teachings of Pagani in view of JP '374, based on Beshty, since Beshty teaches a method for producing hydrogen by a steam reforming method, and wherein the hydrogen may be used for hydrogenation, for fuel cells, and the production of electricity, and Pagani in view of JP '374 teach a process for producing hydrogen by a steam reforming method.


However, the comments set forth above concerning the combination of Pagani and JP '374 are equally applicable to this rejection.

Since claims 38-40 are all dependent on claim 21, and since claim 21 is directed to subject matter which is not suggested by Pagani and JP '374 as indicated above, it is apparent that even if Beshty is considered the references would still not suggest the present invention.

Therefore, in view of the foregoing remarks, it is submitted that each of the grounds of rejection set forth by the Examiner has been overcome, and that the application is in condition for allowance. Such allowance is solicited.

Respectfully submitted,

Ola OLSVIK

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